

Evaluation of Synthesized Sign and Visual Speech by Deaf



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INTRODUCTION

Motivation:

- Full replacement of a sign language interpreter by a computer
- Facilitation of two-way communication between the deaf and hearing people
- Previous study was conducted with hearing subjects [MLMI2007]

Purpose:

- No experiences with contribution of synthesized sign speech by deaf
- Explore the decline of understandability, if the signs are only lipread

SYNTHESIS SYSTEM

Provides the manual component of signed speech

- Rule based synthesizer [MLMI2007]
- The lexicon based on the symbolic notation HamNoSys

Includes the non-manual component too

- Czech talking head system [ICSLP2008]

TEST MATERIAL

The synthesized animation of isolated signs

- The signs collected from the curriculum of the preliminary class
- The video records of a sign language speaker are not included

The symbolic notation of signs

- For the manual component of signs
- The sign editor was used with accordance Czech sign speech vocabulary

Non-manual component is expressed by lip articulation

- The phonetic transcription of signs
- Selection of sufficient speech rate

List of used signs:

Kolo [O...]
lampa [2345...]
máma [m...]
míša [m...]
motyka [m...]
okno [o...]
polévka [p...]
Postel [p...]
pusa [p...]
Zpívat [z...]

The signs captured into two types of video records:

- A The entire animated character
 - manual component
 - simultaneously expressed non-manual component
- B detail on the head of animation model
 - the manual component is not controlled



Format of the records:

- video 372x480 pixels, 25 fps, XVID MPEG4 codec
- audio no sound track

The video records were checked by the teacher



The multiple-choice test with 3 response options:

- randomly arranged pictures
- one correct response

EVALUATION STUDY

EXPERIMENT 1

Participants: 5 deaf pupils from the preliminary and the first class (5-6 years)

PROCEDURE:

TEST 1

Two immediately consecutive parts:

A)

- The overall perception of signed speech
- 10 video records capturing sign speech (manual and non-manual)
- The picture of signed character on the wall approximately 30 cm high

B)

- Lip-reading test (non-manual)
- Projected picture of head: 30 cm

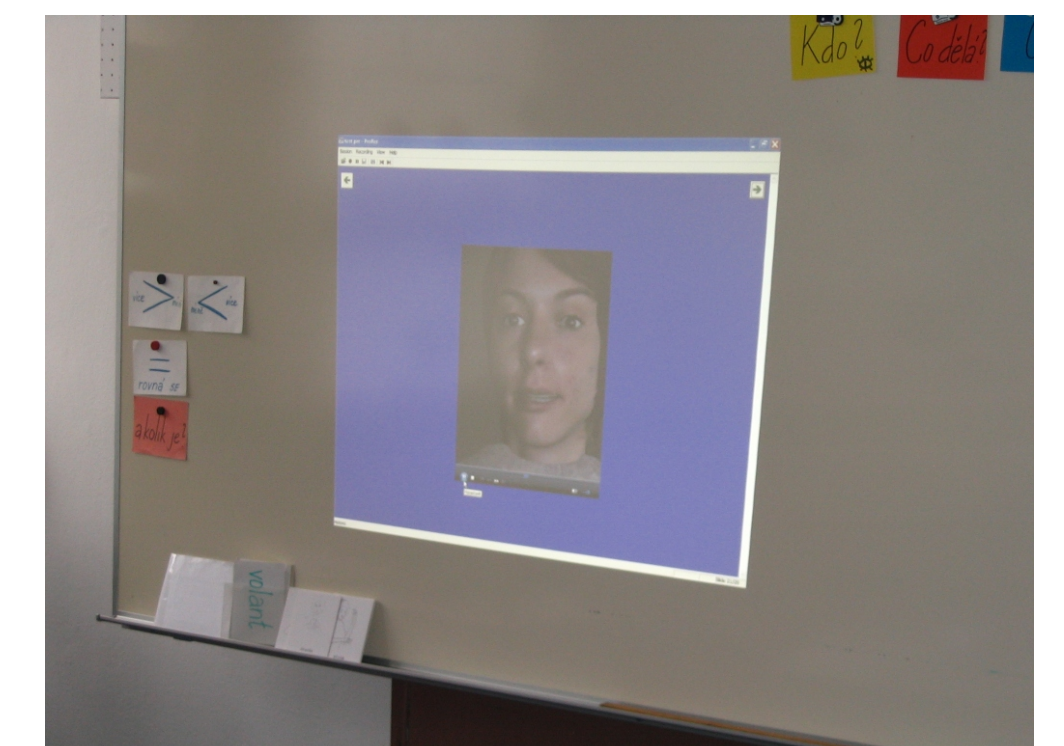
TEST 2

Repetition of TEST 1 after three weeks

EXPERIMENT 2

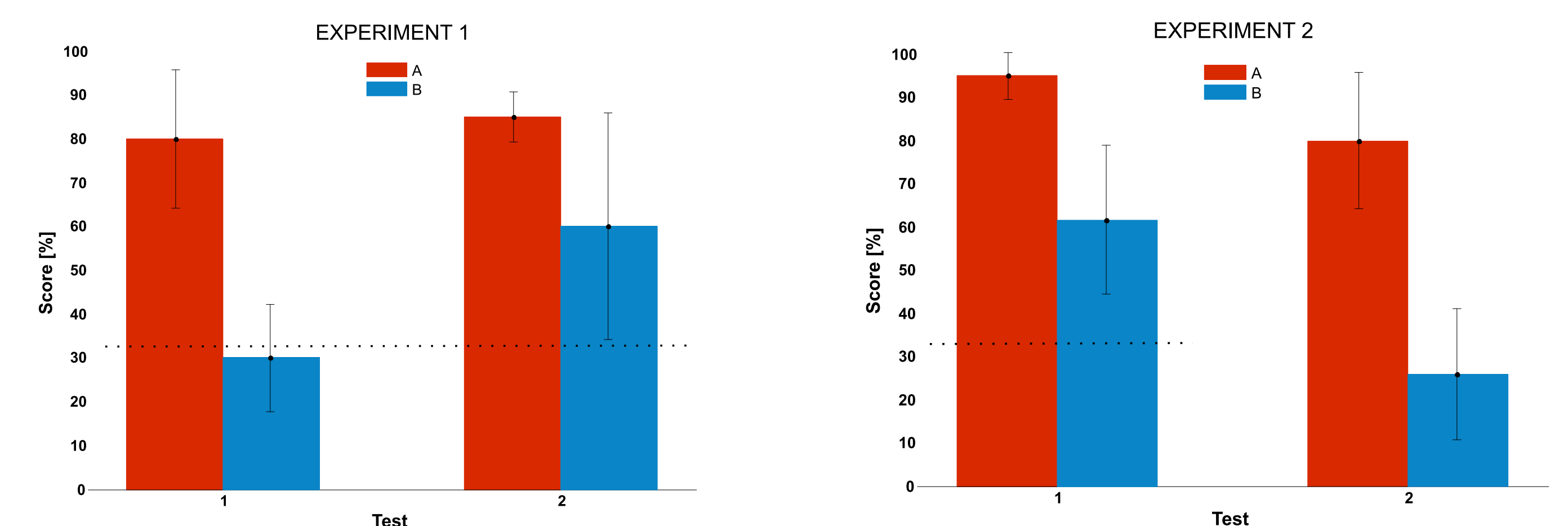
Participants: 6 deaf pupils from the sixth and seventh class (11-13 years)

- The procedure of second experiment was the same.
- The pupils did not use in TEST 2 the sheets of multiple-choice test



RESULTS

Score: correct answer one point and wrong none point



HYPOTHESIS 1:

Was the multiple-choice test filled by a chance?

- One-sample and one-sided t-test ($\alpha < 0.01$) for both tests of the first experiment for the TEST1 of the second experiment
- The chance level 33.3%
- Significantly better understanding of the **signed speech** than a chance for TEST 1 and TEST 2 of EXPERIMENT 1 (younger pupils) for TEST 1 of EXPERIMENT 2 (older pupils)
- Significantly better understanding of the **visual speech** than a chance for TEST 1 of EXPERIMENT 2

	EXPERIMENT 1		EXPERIMENT 2	
	A	B	A	B
TEST 1	80%	30%	95%	62%
TEST 2	85%	60%	80%	26%

HYPOTHESIS 2:

Does the removal of the non-manual component cause a significant decrease in understanding?

- Testing is at the significance level $\alpha < 0.01$
- One-sided and paired t-test

The significant decrease of understanding:

50%, TEST 1, EXPERIMENT 1
33%, TEST 1, EXPERIMENT 2
54%, TEST 2, EXPERIMENT 2

EVALUATION STUDY

Purpose:

- to score quality of synthesized sign speech (isolated signs).
- to compare the perception of sign speech and visual speech.

Participants:

- deaf children from primary school

Method:

- projection of the tested words on the wall in the classroom by the data projector
- 5 extra non-scored words at the beginning of the experiments